

# IS GRAPHQL REALLY HELPFUL IN CONTRAST TO REST API'S?

Daniel Danielecki

# WHAT IS A GRAPHQL?

Query language for API's, **alternative** (not replacement) for REST.

# GRAPHQL VS REST

# GRAPHQL VS REST

Feature	REST	GraphQL	Similar/Different
HTTP	Yes	Yes	Similar
API endp.	Yes	Yes	Similar
JSON	Yes	Yes	Similar
Request	Rigid	Flexible	Different
Call API	Endpoint	Query	Different
Response	Server	Client	Different
Size resp.	Server	Client	Different

# WHY GRAPHQL?

# FRONTEND?

# WHY GRAPHQL?

Query only what you need.

# BACKEND?

# WHY GRAPHQL?

- No Over/Under-Fetching
- Non-null
- Performance\*
- Single Endpoint
- Strong Typing
- Subscriptions
- Versioning
- ...

# GRAPHQL?

(optional)

# GRAPHQL BASICS

(optional)

# GRAPHQL BASICS: SCHEMA

(optional)

```
type Query { ... }
type Mutation { ... }
type Subscription { ... }
input CreateUserInput { ... }
```

(optional)

# GRAPHQL BASICS: OBJECT TYPES

(optional)

# GRAPHQL BASICS: OBJECT TYPES

```
type User {  
    id: ID!  
    name: String!  
    email: String!  
    age: Int  
    posts: [Post!]!  
}  
  
type Post {  
    id: ID!  
    title: String!  
    body: String!  
    author: User!  
}
```

(optional)

# GRAPHQL BASICS: QUERY

(optional)

# GRAPHQL BASICS: QUERY

```
type Query {  
  users(query: String): [User!]!  
  posts(query: String): [Post!]!  
  dummy: User!  
  post: Post!  
}
```

(optional)

# GRAPHQL BASICS: QUERY

```
query {
  users {
    id
  }
}
```

(optional)

**GRAPHQL QUERY == "GET"**

(optional)

# GRAPHQL MUTATIONS

(optional)

# GRAPHQL MUTATIONS

```
type Mutation {  
  createUser(data: CreateUserInput!): User!  
  deleteUser(id: ID!): User!  
  updateUser(id: ID!, data: UpdateUserInput!): User!  
}  
  
input CreateUserInput {  
  name: String!  
  email: String!  
  age: Int  
}
```

(optional)

# GRAPHQL MUTATIONS

```
mutation {
  createUser(data: { name: "Daniel", email: "foo@example.com",
    id
    email
    age
  })
}
```

(optional)

# **GRAPHQL MUTATION**



**"POST", "PUT", "PATCH", "DELETE"**  
**(CRUD)**

(optional)

# GRAPHQL SUBSCRIPTIONS

(optional)

# GRAPHQL SUBSCRIPTIONS

```
type Subscription {  
  count: Int!  
}
```

(optional)

# GRAPHQL SUBSCRIPTIONS

```
subscription {  
  count  
}
```

(optional)

# GRAPHQL SUBSCRIPTION

=

# WEBSOCKETS

(optional)

# DEMO?

Simplest example of GraphQL query.

**BEYOND THE  
BASICS**

# LEARNING CURVE

# LEARNING CURVE

GraphQL takes **more time** to learn.

# CACHING

# CACHING

GraphQL's caching **is more complex.**

# CACHING: REST (EXPRESS.JS)

```
const express = require('express');
const app = express();
const port = 3000;

app.get('/api/resource', (req, res) => {
  const resource = {
    id: 1,
    name: "Resource",
    value: "Some data",
    lastModified: new Date().toISOString()
  };

  // Set Cache-Control header
  res.setHeader('Cache-Control', 'public, max-age=3600') .
```

# CACHING: GRAPHQL (APOLLO SERVER)

```
const { ApolloServer, gql } = require('apollo-server');
const { ApolloServerPluginCacheControl } = require('apollo-ser

// Schema definition
const typeDefs = gql`  
  type Query {  
    resource(id: ID!): Resource  
  }  
  
  type Resource {  
    id: ID!  
    name: String  
    value: String  
  }`
```

# CACHING: GRAPHQL (APOLLO CLIENT)

```
import { ApolloClient, InMemoryCache, gql } from '@apollo/client'

// Initialize Apollo Client
const client = new ApolloClient({
  uri: 'https://example.com/graphql',
  cache: new InMemoryCache()
});

// Query
const GET_RESOURCE = gql`  
  query GetResource($id: ID!) {  
    resource(id: $id) {  
      id  
      name  
    }  
  }`
```

# ERROR HANDLING

# ERROR HANDLING

Beyond 200 when an error occurred.

# ERROR HANDLING

## REST

---

Status codes to indicate  
nature of errors

---

Error messages within  
response body

## GraphQL

---

Error classes

---

Error messages  
within resolvers

# ERROR HANDLING: REST

```
try {  
    const resource = await Resource.findByPk(id);  
    if (resource) {  
        res.json(resource);  
    } else {  
        res.status(404).json({ error: 'Resource not found' });  
    }  
} catch (error) {  
    res.status(500).json({ error: error.message });  
}
```

# ERROR HANDLING: GRAPHQL

```
try {
  const resource = await Resource.findByPk(id);
  if (resource) {
    return resource;
  } else {
    throw new UserInputError('Resource not found');
  }
} catch (error) {
  throw new Error('Failed to fetch resource');
}
```

# DEMO

Let's see an error.

# SOME ERRORS

!=  
==

## 200

- Bad Request: 400
- Unauthorized: 401
- Forbidden: 403
- Internal Server Error: 500

# GLOBAL OBJECT IDENTIFICATION

# GLOBAL OBJECT IDENTIFICATION

Let my frontend fetch a single ID.

# GLOBAL OBJECT IDENTIFICATION: GRAPHQL

```
query {
  user(id: "1") {
    id
    name
    email
  }
}
```

# GLOBAL OBJECT IDENTIFICATION: REST

```
GET /resources/:id
```

# PAGINATION

# PAGINATION

Let my frontend fetch a page.

# PAGINATION: GRAPHQL

```
query {
  items(limit: 10, offset: 20) {
    total
    limit
    offset
    items {
      id
      name
    }
  }
}
```

# PAGINATION: REST

```
GET /api/items?limit=10&offset=20
```

# SORTING

# SORTING

Let my frontend sort the results.

# SORTING: GRAPHQL

```
query {
  items(sort: { field: "name", order: DESC }) {
    id
    name
  }
}
```

# SORTING: REST

```
GET /api/items?sortBy=name&order=desc
```

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W

# STACKOVERFLOW

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GraphQL is an API technology designed to describe the complex, nested data dependencies of modern web applications. It is often considered an alternative to SOAP or REST

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[How to query all the GraphQL type fields without writing a long query?](#)

Assume you have a GraphQL type and it includes many fields. How to query all the fields without writing down a long query that includes the names of all the fields? For example, if I have these ...

[PHP](#) [php](#) [laravel](#) [graphql](#)

BlackSigma 3,785 asked Dec 10, 2015 at 10:50

[graphql-php](#)

276 votes

[✓ 12 answers](#)

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[Nodemon Error: "System limit for number of file watchers reached"](#)

I'm learning GraphQL and am using prisma-binding for GraphQL operations. I'm facing this nodemon error while I'm starting my Node.js server and its giving me the path of schema file which is...

[node.js](#) [graphql](#) [nodemon](#)

Rehan Sattar 3,825 asked Dec 26, 2018 at 9:50

275 votes

[✓ 9 answers](#)

74k views

[When and How to use GraphQL with microservice architecture](#)

I'm trying to understand where GraphQL is most suitable to use within a microservice architecture. There is some debate about having only 1 GraphQL schema that works as API Gateway proxying...

[architecture](#) [microservices](#) [graphql](#)

Fabrizio Fenoglio 5,907 asked Jun 28, 2016 at 9:04

216 votes

[✓ 4 answers](#)

287k views

[How to properly make mock throw an error in Jest?](#)

I'm testing my GraphQL api using Jest. I'm using a separate test suit for each query/mutation I have 2 tests (each one in a separate test suit) where I mock one function (namely, Meteor's call-...)

[javascript](#) [meteor](#) [graphql](#) [jestjs](#)

Le garcon 7,817 asked Apr 14, 2018 at 19:18

187 votes

[✓ 2 answers](#)

73k views

[In GraphQL what's the meaning of "edges" and "node"?](#)

I am consuming a GraphQL endpoint and I get results that contain edges and node tags. I am supplying a clean JSON structure for my query, so this doesn't make sense to me. It seems as if the...

[json](#) [graphql](#)

Ska 6,848 asked Mar 6, 2017 at 10:15

183 votes

[What's the point of input type in GraphQL?](#)

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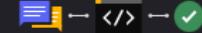
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# How to query all the GraphQL type fields without writing a long query?

[Ask Question](#)

Asked 8 years, 6 months ago Modified 2 days ago Viewed 344k times Part of PHP Collective



Assume you have a GraphQL type and it includes many fields. How to query all the fields without writing down a long query that includes the names of all the fields?

**368**

For example, If I have these fields :



```
public function fields()
{
    return [
        'id' => [
            'type' => Type::nonNull(Type::string()),
            'description' => 'The id of the user'
        ],
        'username' => [
            'type' => Type::string(),
            'description' => 'The email of user'
        ],
        'count' => [
            'type' => Type::int(),
            'description' => 'login count for the user'
        ]
    ];
}
```



To query all the fields usually the query is something like this:

```
FetchUsers{users(id:"2"){id,username,count}}
```

But I want a way to have the same results without writing all the fields, something like this:

```
FetchUsers{users(id:"2"){*}}
//or
FetchUsers{users(id:"2")}
```

Is there a way to do this in GraphQL ??

I'm using *Folkloreatelier/laravel-graphql* library.
[PHP](#) [php](#) [laravel](#) [graphql](#) [graphql-php](#)


PHP Collective

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This question is in a collective: a subcommunity defined by tags with relevant content and experts.

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en bouw je app  
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services



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Unfortunately what you'd like to do is not possible. GraphQL requires you to be explicit about specifying which fields you would like returned from your query.

**355**

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answered Dec 11, 2015 at 15:03



Peter Horne

6,720 • 7 • 39 • 50

---

17 ▲ Ok, and if I request some object of an unknown form from backend which I'm supposed to proxy or  
▼ send back? – meandre Nov 30, 2016 at 6:25

---

57 ▲ @meandre, the whole idea of graphql is that there is no such thing as an "unkown form". – s.meijer  
▼ Dec 28, 2016 at 22:16

# WON'T WORK

```
query {  
  *  
}
```

# WON'T WORK

```
query {  
  users {  
    *  
  }  
}
```

# INTROSPECTION

## Learn

## Learn &gt; Introspection

Question? Give us feedback →

Introduction

Queries and Mutations

Schemas and Types

Validation

Execution

Introspection

## Best Practices

Best Practices

Thinking in Graphs

Serving over HTTP

Authorization

Pagination

Global Object Identification

Caching

# Introspection

Edit this page

It's often useful to ask a GraphQL schema for information about what queries it supports. GraphQL allows us to do so using the introspection system!

For our Star Wars example, the file [starWarsIntrospection-test.ts](#) contains a number of queries demonstrating the introspection system, and is a test file that can be run to exercise the reference implementation's introspection system.

We designed the type system, so we know what types are available, but if we didn't, we can ask GraphQL, by querying the `__schema` field, always available on the root type of a Query. Let's do so now, and ask what types are available.

```
{  
  __schema {  
    types {  
      name  
    }  
  }  
}
```

Wow, that's a lot of types! What are they? Let's group them:

- `Query`, `Character`, `Human`, `Episode`, `Droid` - These are the ones that we defined in our type system.
- `String`, `Boolean` - These are built-in scalars that the type system provided.
- `__Schema`, `__Type`, `__TypeKind`, `__Field`, `__InputValue`, `__EnumValue`, `__Directive` - These all are preceded with a double underscore, indicating that they are part of the introspection system.

Now, let's try and figure out a good place to start exploring what queries are available. When we designed our type system, we specified what type all queries would start at; let's ask the introspection system about that!

```
{  
  __schema {  
    queryType {  
      name  
    }  
  }  
}
```

```
"data": {  
  "queryType": {  
    "name": "Query"  
  }  
}
```

# DEMO

Introspection in practice.

```
const server = new ApolloServer({
  typeDefs,
  resolvers,
  introspection: process.env.NODE_ENV !== 'production'
});
```



CHANGE SCHEMA

## Type List

Search Schema...

### Root

No Description

### Film

A single film.

### Person

An individual person or character within the Star Wars universe.

### Planet

A large mass, planet or planetoid in the Star Wars Universe, at the time of 0 ABY.

### Species

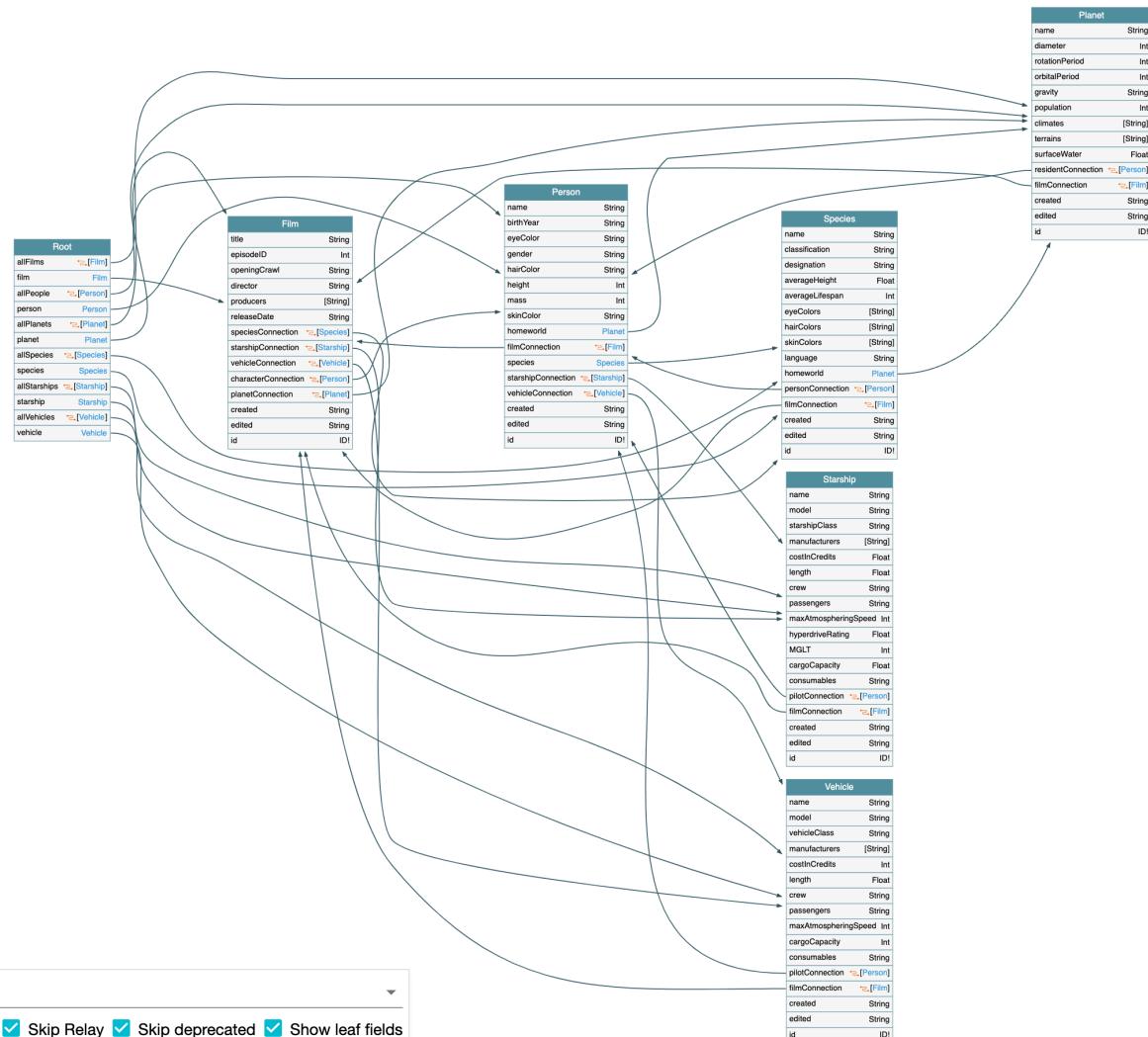
A type of person or character within the Star Wars Universe.

### Starship

A single transport craft that has hyperdrive capability.

### Vehicle

A single transport craft that does not have hyperdrive capability



Root

Sort by Alphabet  Skip Relay  Skip deprecated  Show leaf fields



RESET



This content represents the latest contributions to the Web Security Testing Guide, and may frequently change.



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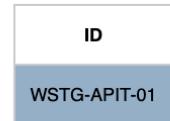
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### Testing GraphQL



#### Summary

GraphQL has become very popular in modern APIs. It provides simplicity and nested objects, which facilitate faster development. While every technology has advantages, it can also expose the application to new attack surfaces. The purpose of this scenario is to provide some common misconfigurations and attack vectors on applications that utilize GraphQL. Some vectors are unique to GraphQL (e.g. [Introspection Query](#)) and some are generic to APIs (e.g. [SQL injection](#)).

Examples in this section will be based on a vulnerable GraphQL application [poc-graphql](#), which is run in a docker container that maps `localhost:8080/GraphQL` as the vulnerable GraphQL node.

#### Test Objectives

- Assess that a secure and production-ready configuration is deployed.
- Validate all input fields against generic attacks.
- Ensure that proper access controls are applied.

#### How to Test

Testing GraphQL nodes is not very different than testing other API technologies. Consider the following steps:

##### Introspection Queries

Introspection queries are the method by which GraphQL lets you ask what queries are supported, which data types are

The OWASP® Foundation works to improve the security of software through its community-led open source software projects, hundreds of chapters worldwide, tens of thousands of members, and by hosting local and global conferences.

#### WSTG Contents

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Summary

Blog / GraphQL / Security / Why You Should Disable GraphQL Introspection In Production – GraphQL Security

• May 7, 2021

# Why You Should Disable GraphQL Introspection In Production – GraphQL Security



Khalil Stemmler

Introspection

What is it?

What do we need introspection for?

Introspection in production

Public vs. private APIs

Use case: Learn all possible Graph...

To utilize production data

Problems with introspection in prod...

Revealing sensitive information

Easy to discover potentially malicio...

Turning off introspection in product...

Use a schema registry to update, b...

Register your schema

Exploring the schema's shape and ...

Invite team members to explore yo...

Conclusion

Share article

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## GraphQL Security



# CIRCULAR QUERIES

# DEMO

Digging with nesting.

**STANDARDIZATION  
VS  
FRAGMENTATION**

# STANDARDIZATION: REST

HTTP methods (GET, POST, PUT, DELETE),  
status codes (200, 404, 500).

# FRAGMENTATION: GRAPHQL

Apollo Server, GraphQL Yoga, Envelop, Express-GraphQL (deprecated), Apollo Client, Relay, urql.

# PROJECTS

graphql / dataloader

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**andrew-demb** Update readme badge to use GitHub CI instead of unused Travis... 003c045 · 3 months ago 215 Commits

.changeset chore: v2.2.2 last year

.github Update tested node version (#329) last year

examples chore: add prettier to eslint run (#327) last year

flow-typed/npm Migrate tests to Jest (#212) 5 years ago

resources chore: update prepublish script last year

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LICENSE Evergreen LICENSE/Copyright (#282) 3 years ago

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babel.config.js chore: add prettier to eslint run (#327) last year

package.json chore: v2.2.2 last year

renovate.json chore: add renovate bot (#306) 2 years ago

yarn.lock Bump minimatch from 3.0.4 to 3.1.2 (#324) last year

About

DataLoader is a generic utility to be used as part of your application's data fetching layer to provide a consistent API over various backends and reduce requests to those backends via batching and caching.

nodejs graphql batch dataloader

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v2.2.2 Latest on Feb 13, 2023 + 9 releases

Packages

No packages published

Used by 324k

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Aug 9, 2023 IvanGoncharov v2.0.0 1e51d57 Compare

# v2.0.0 Latest

## v2.0.0 (2023-08-09)

Made in Ukraine 🇺🇦

You can show your support by helping my country to fight this war:  
<https://opencollective.com/graphql-voyager>  
All collected money after expenses goes to Ukrainian paramedics deployed alongside troops.

**Breaking Change** ⚡

- [#317 Remove 'init' and 'GraphQLVoyager' exports \(@IvanGoncharov\)](#)
- [#318 Remove support for passing function as introspection \(@IvanGoncharov\)](#)
- [#319 Delete `voyager.min.js` from the dist \(@IvanGoncharov\)](#)

**New Feature** 🎉

- [#323 Drop `react-dom` from peerDependencies \(@IvanGoncharov\)](#)
- [#340 Switch to accepting schema as introspection \(@IvanGoncharov\)](#)
- [#348 Add cache for SVG generate by graphviz \(@IvanGoncharov\)](#)

**Bug Fix** 🐛

- [#325 Track resize of viewport instead of entire page \(@IvanGoncharov\)](#)

graphql-kit / graphql-voyager

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## Voyager fails to load (Unexpected reserved word at voyager:42:29: "await") #403 [New issue](#)

[Open](#) craigdrayton opened this issue 2 weeks ago · 2 comments

craigdrayton commented 2 weeks ago

I'm trying to use Voyager with a GraphQL Yoga server running Express:

```
import express from "express";
import { createSchema, createYoga } from "graphql-yoga";
import { express as voyagerMiddleware } from "graphql-voyager/middleware/index.js";
import typeDefs from "./generated/schema.json" assert { type: "json" };

const server = express();
server.use("/voyager", voyagerMiddleware({ endpointUrl: "/graphql" }));

const yoga = createYoga({ schema: createSchema({ typeDefs }) });
server.use(yoga.graphqlEndpoint, yoga);

server.listen(4000, () => {
  console.log("GraphQL Server is listening on http://localhost:4000/graphql");
});
```

When I try to access <http://localhost:4000/voyager> I get "Unexpected reserved word at voyager:42:29" error in console.

```
<!DOCTYPE html>
<html>
<head>
<meta charset=utf-8 />
<meta name="viewport" content="user-scalable=no, initial-scale=1.0, minimum-scale=1.0, maximum-scale=1.0">
<title>GraphQL Voyager</title>
<style>
  body {
    padding: 0;
    margin: 0;
```

Assignees

No one assigned

Labels

None yet

Projects

None yet

Milestone

No milestone

Development

No branches or pull requests

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### Build GraphQL-powered Generative AI applications with Amazon Bedrock and AWS AppSync

In this article, Ike Gabriel Yuson delves into the intersection of GraphQL and generative AI, demonstrating how Amazon Bedrock and AWS AppSync can be leveraged to build scalable and extensible applications. The author illustrates the benefits of using GraphQL's flexible schema and query capabilities to seamlessly integrate AI-generated content with existing data sources. By exploring real-world use cases and best practices, this article provides a comprehensive guide for developers seeking to harness the power of GraphQL in their generative AI projects.



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A community building flexible open source tools for GraphQL.

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Sponsor

# UNIT TESTING

# UNIT TESTING: REST

```
const express = require('express');
const app = express();
app.use(express.json());

let resources = [{ id: 1, name: 'Resource1' }];

app.get('/api/resources', (req, res) => {
  res.json(resources);
});

app.post('/api/resources', (req, res) => {
  const newResource = { id: resources.length + 1, name: req.body.name };
  resources.push(newResource);
  res.status(201).json(newResource);
});
```

# UNIT TESTING: GRAPHQL

```
const { ApolloServer, gql } = require('apollo-server');

const typeDefs = gql`  
  type Resource {  
    id: ID!  
    name: String!  
  }  
  
  type Query {  
    resources: [Resource]  
  }  
  
  type Mutation {  
    createResource(name: String!): Resource  
  }`
```

# UNIT TESTING: REST

```
const request = require('supertest');
const app = require('../app');
const { expect } = require('chai');

describe('REST API', () => {
  it('should get all resources', async () => {
    const res = await request(app).get('/api/resources');
    expect(res.status).to.equal(200);
    expect(res.body).to.be.an('array');
    expect(res.body.length).to.equal(1);
  });

  it('should create a new resource', async () => {
    const res = await request(app).post('/api/resources').send({
      name: 'New Resource'
    });
    expect(res.status).to.equal(201);
    expect(res.body.name).to.equal('New Resource');
  });
});
```

# UNIT TESTING: GRAPHQL

```
const { createTestClient } = require('apollo-server-testing');
const { expect } = require('chai');
const server = require('../schema');

const { query, mutate } = createTestClient(server);

describe('GraphQL API', () => {
  it('should get all resources', async () => {
    const GET_RESOURCES = `

      query {
        resources {
          id
          name
        }
      }
    `

    const result = await query(GET_RESOURCES)

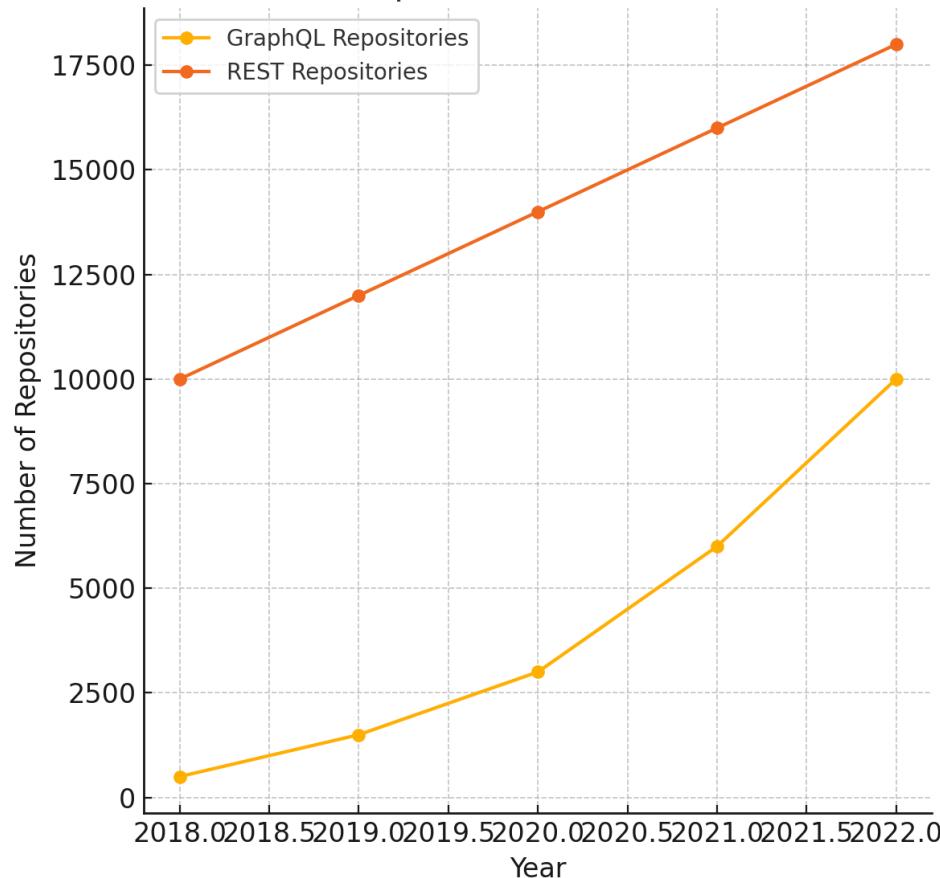
    expect(result).to.be.an('object')
    expect(result.data).to.be.an('object')
    expect(result.data.resources).to.be.an('array')
    expect(result.data.resources.length).to.be.gte(1)
  })
})
```

# DEMO

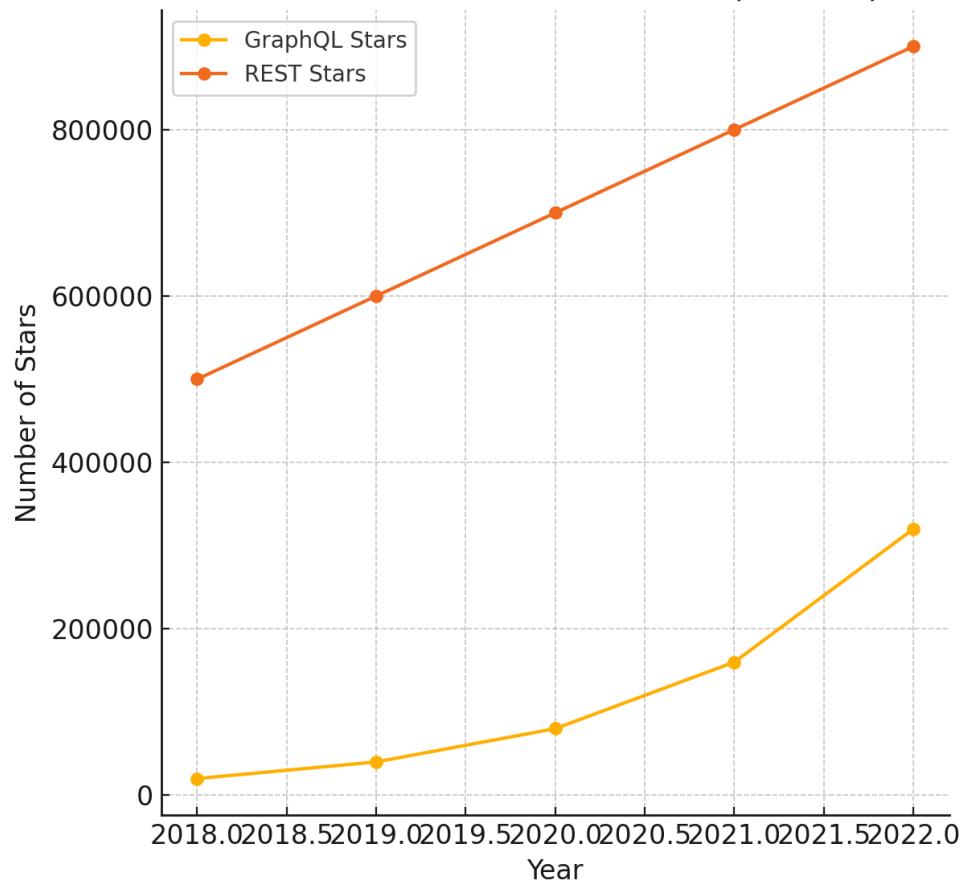
Unit Testing in GraphQL.

# TRENDS

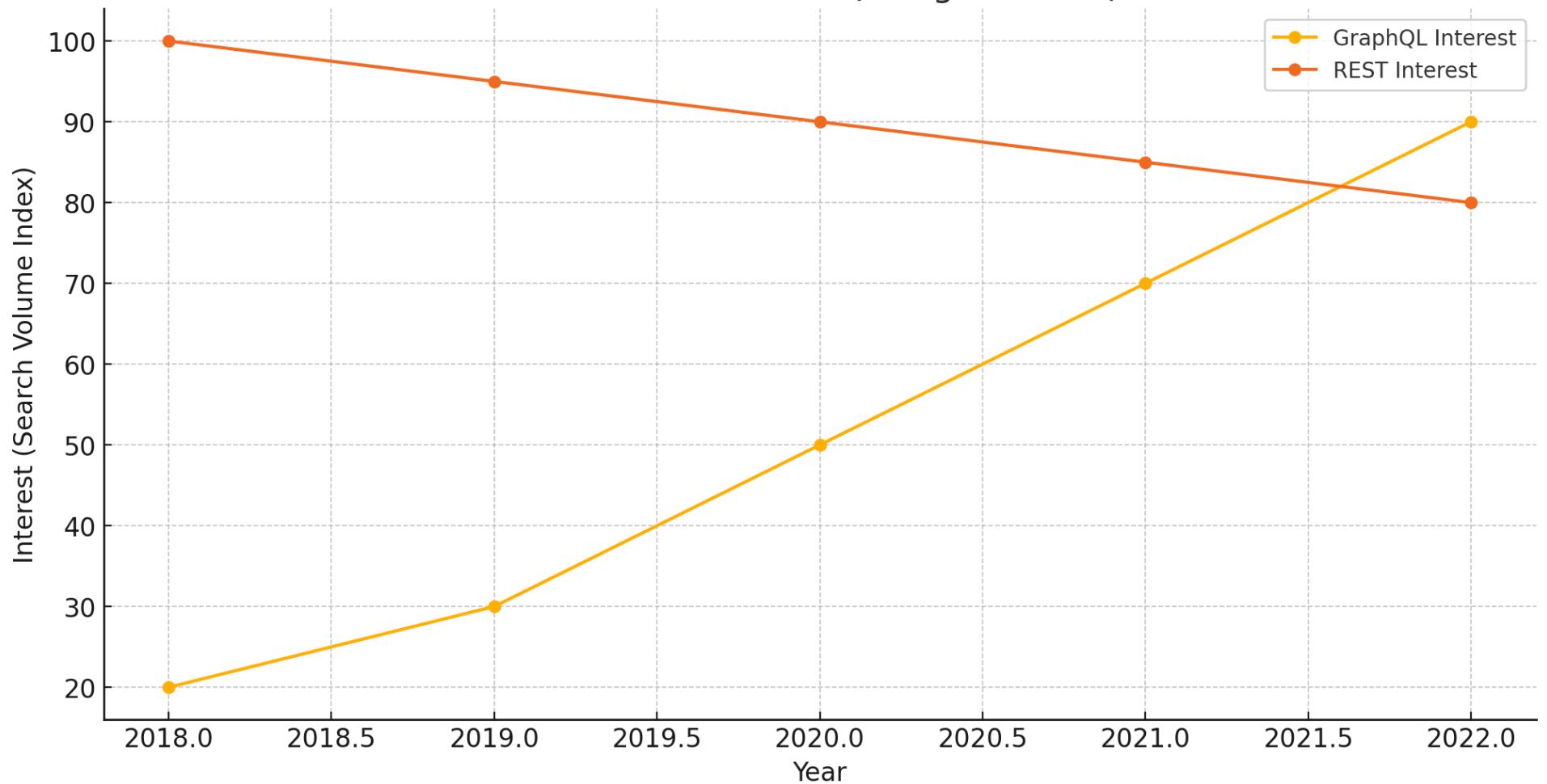
### Number of Repositories Over Time (GitHub)



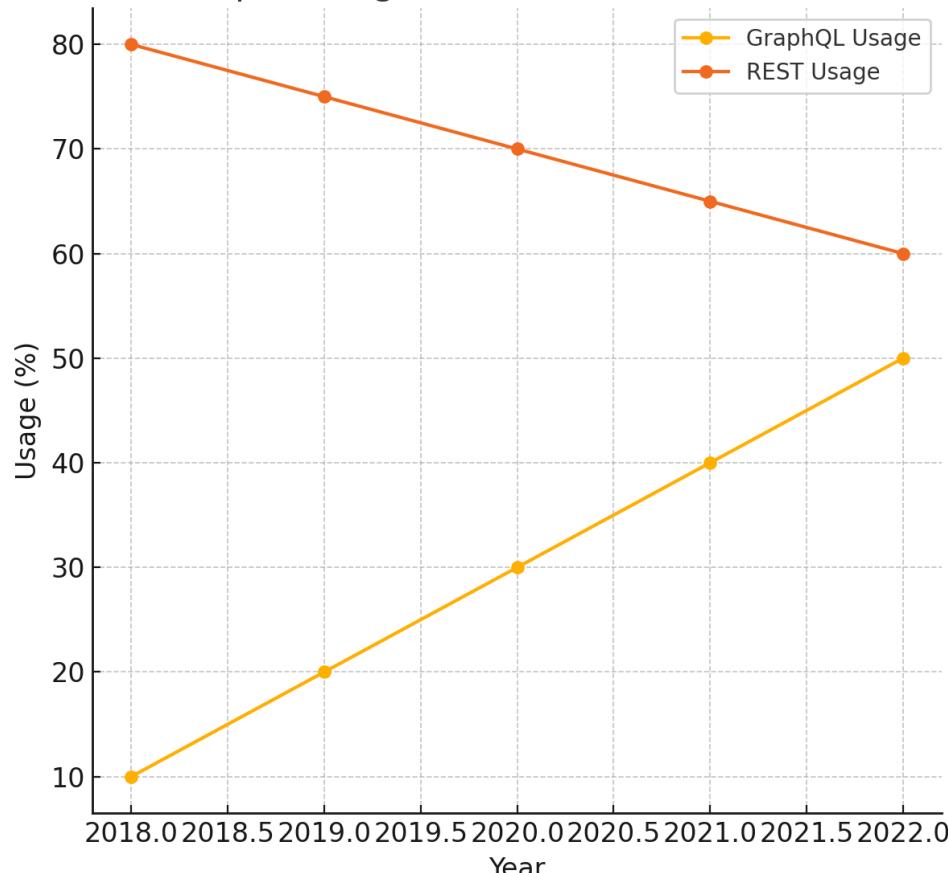
### Number of Stars Over Time (GitHub)



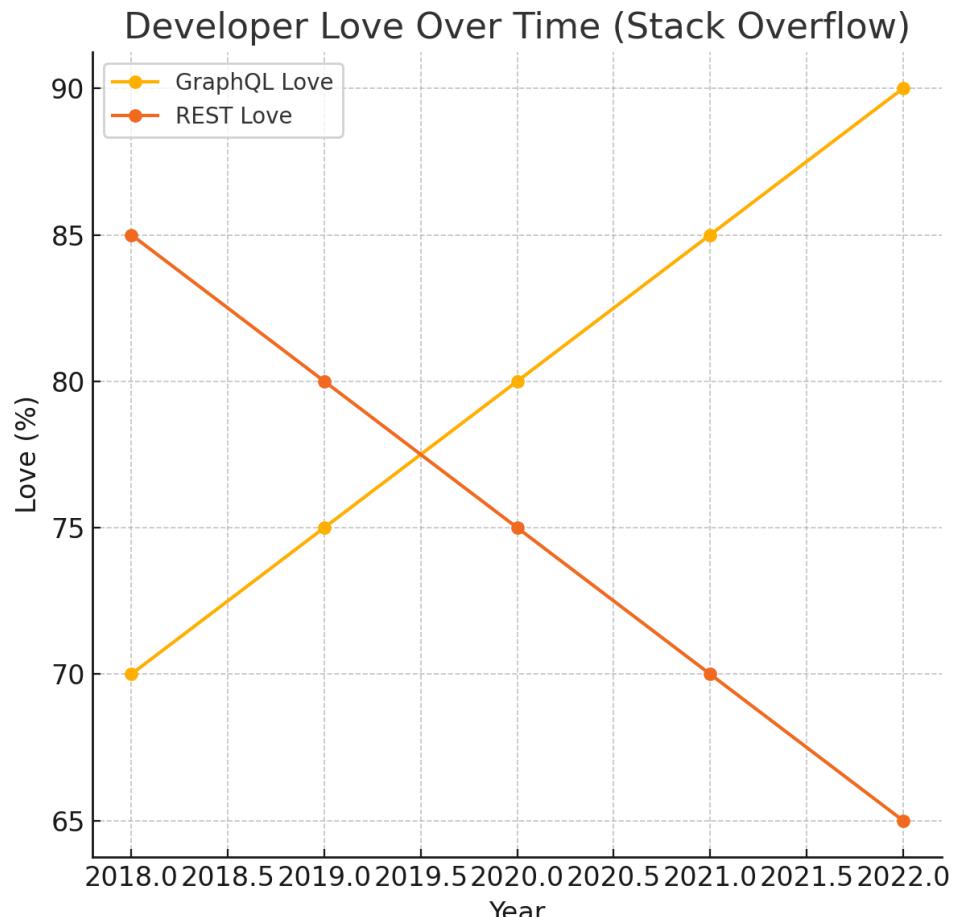
## Interest Over Time (Google Trends)



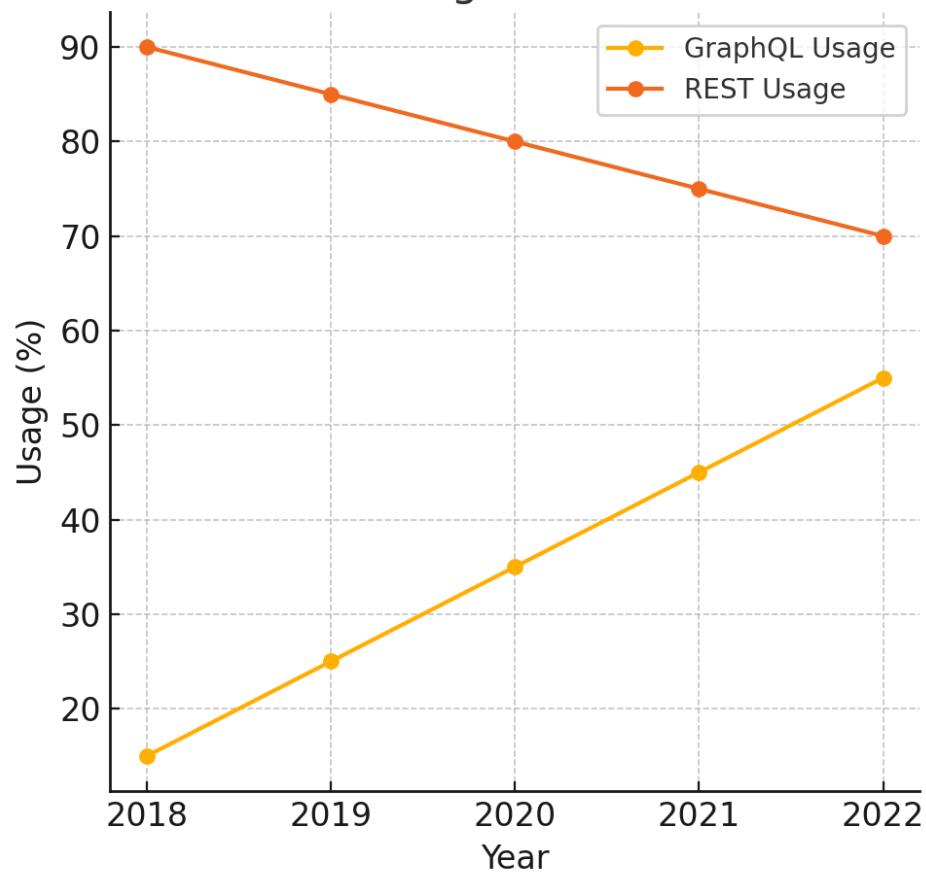
### Developer Usage Over Time (Stack Overflow)



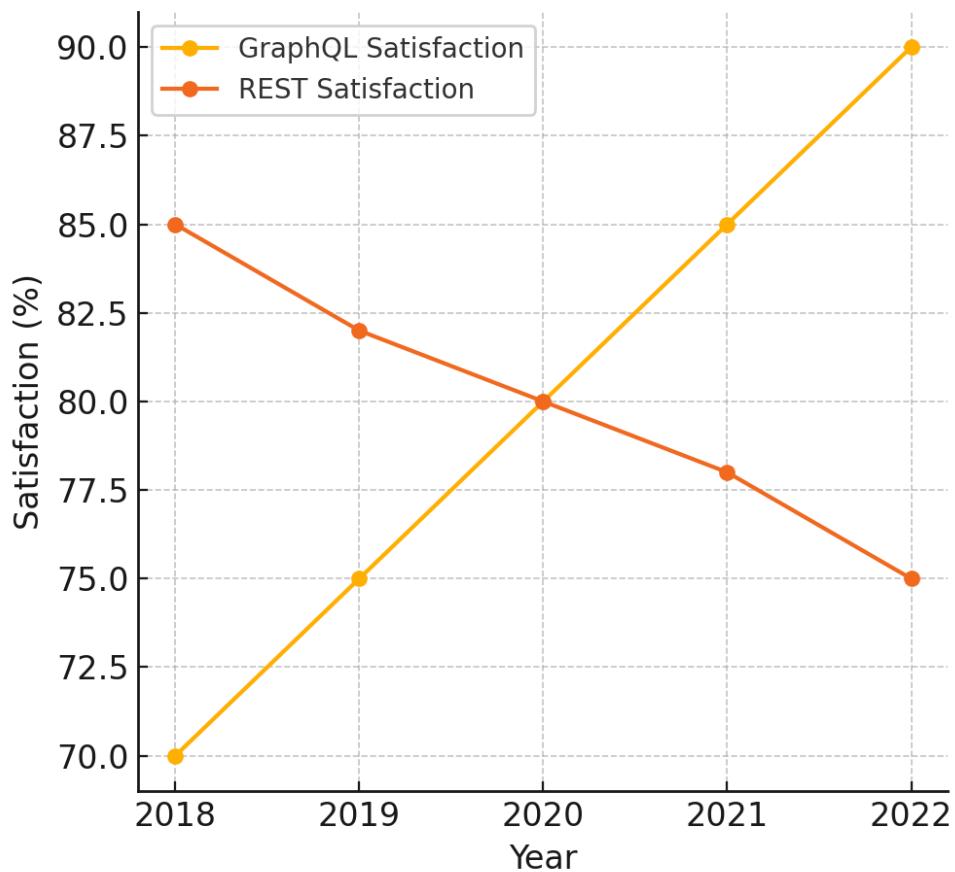
### Developer Love Over Time (Stack Overflow)



### API Usage Over Time



### API Satisfaction Over Time



# CONCLUSION

# USEFUL, BUT

- Caching
- Circular Queries (FE)
- Error Handling
- Introspection
- query \*
- Up-to-date projects
- Unit Testing



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TypeScript ⭐ 27 📈 7

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Swift ⭐ 6

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<https://github.com/detectrev>